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STATOR WITH VARIABLE CONDUCTOR CROSS-SECTIONS IN

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STATOR WITH VARIABLE CONDUCTOR CROSS-SECTIONS IN DIFFERENT BASKETS

Technical task:

Structure

Stator windings of electrical machines can be designed in different ways. One variant is the winding with preformed elements (also called: flat wire winding, hairpin winding, shaped wire winding), which represents the new standard of future developments in e-mobility (Figure 1, left). The wires all have the same copper cross section, which is why the grooves (hole in which the wires are) are parallel flanked (yellow-green, figure 1, right). Since the stator is constructed rotationally symmetrically, the stator teeth must not be parallel-flanked (green-red, Figure 1, right).

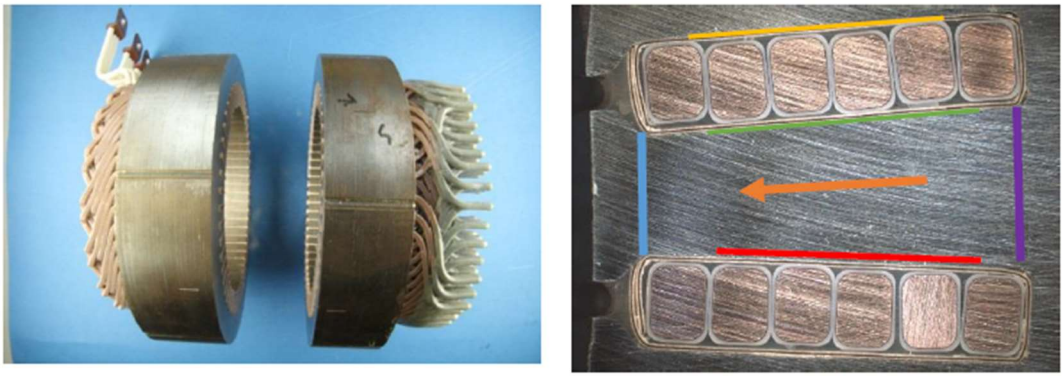


Figure 1: Shaped wire winding in electrical machines

Initial situation:

The disadvantage of the situation described above is that the magnetic flux (orange arrow, Figure 1, right) is conducted through the stator teeth and has its constriction at the blue cross-sectional area. This determines how much torque the electric machine can deliver. The additional cross-section in purple is therefore neither magnetically nor electrically (more copper area) effectively used.

Solution:

As in Figure 2, the tooth could be designed with a profile so that more area is available for the copper conductors. To ensure that the copper winding remains symmetrical from an electromagnetic point of view, the copper cross-section must not change. For this reason, although the aspect ratio is changed, the copper cross-section is left constant. This allows a significantly lower electrical resistance to be realized, which improves efficiency. Alternatively, the size, weight and thus the direct material costs can be reduced while maintaining the same current density.

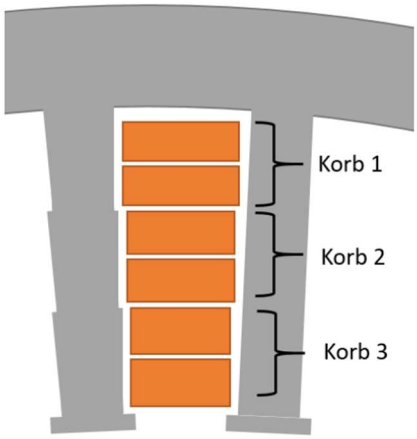
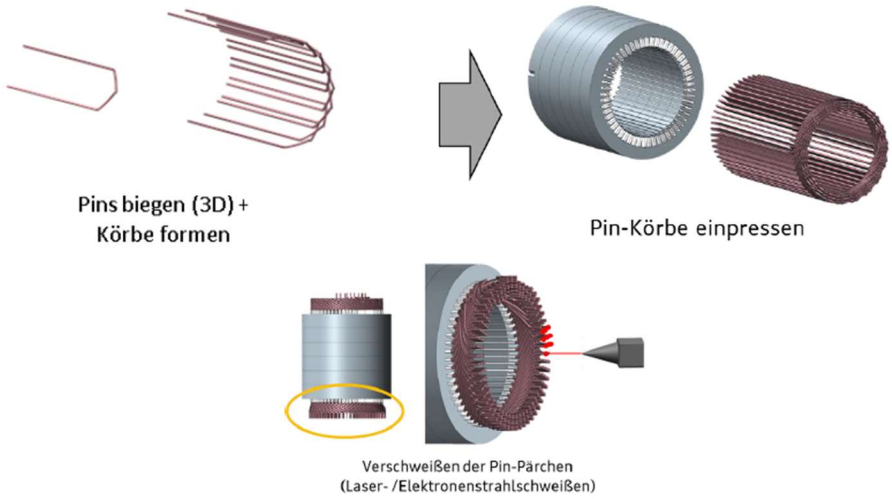


Figure 2: Shaped wire winding in electrical machines

Technical implementation

Each conductor consists of a U-shape. These U-shaped conductors are plugged together to form a basket and then joined together in the stator. The conductors are then welded together on the welding side. A so-called basket jump, in which a change from one conductor with cross-section 1 to the next conductor with cross-section 2 takes place always on the welding side of the stator.



Advantages:

- lower electrical resistance, which improves efficiency
- the size, weight and thus the direct material costs can be reduced while maintaining the same current density